AIRS/MOPITT/TES CO Comparisons

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- This work is supported by NASA through AURA validation.
- AIRS and MOPITT comparison emphasizing the effects of the 1st guess when comparing trace gases between two datasets. AIRS ~ MOPITT CO comparison paper accepted by JGR (Warner *et al.*, 2007).
- AIRS ~ TES comparison emphasizing information contend distributed.

AIRS CO Measurements
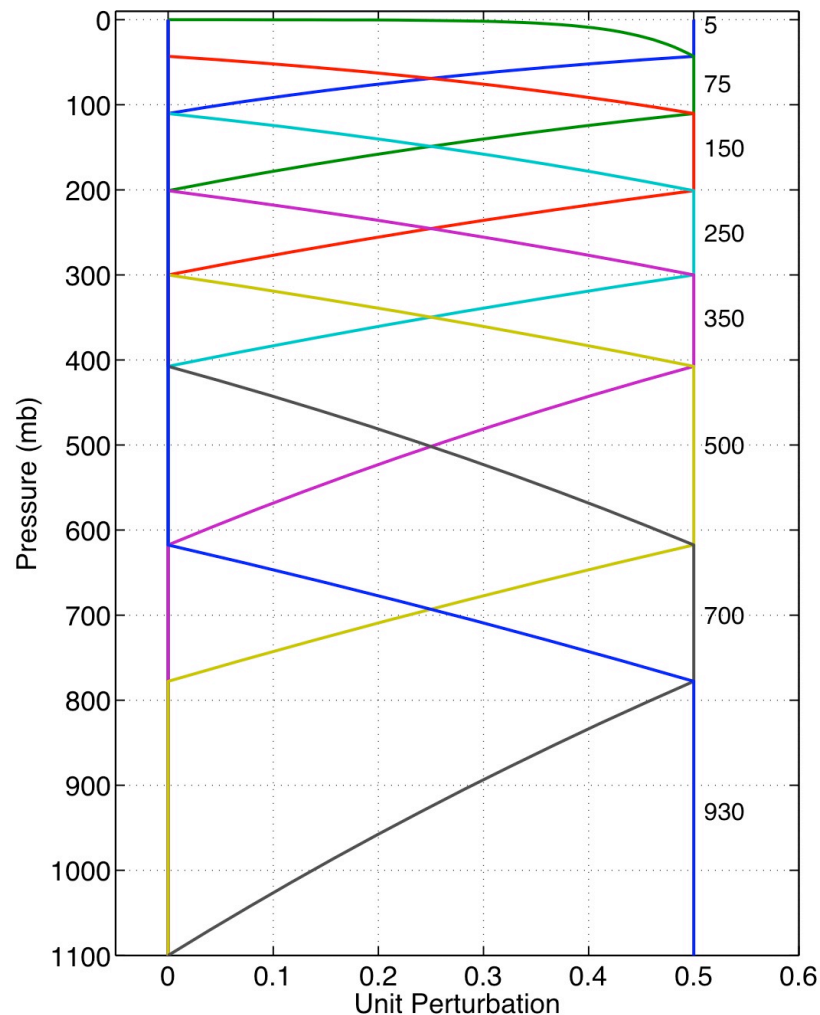
- Data for this study is processed at UMBC.

- AIRS science team retrieval codes are provided by Barnet from NOAA/NESDIS. All retrievals shown are based on v4.8 delivered May 2006.

- Averaging Kernels are computed using formulations provided by Eric Maddy before June 2006, not updated since then.

- Parameters used are consistent with Michele's studies to optimize AIRS CO retrievals (Comer, 2006).

  - Retrieval layers used 8 trapezoidal functions.
  - Damping parameters Bmax=1.75
 - Either AFGL or MOPITT *apriori* single profile is used as the first guess.

AIRS/MOPITT Direct Comparisons During INTEX-A
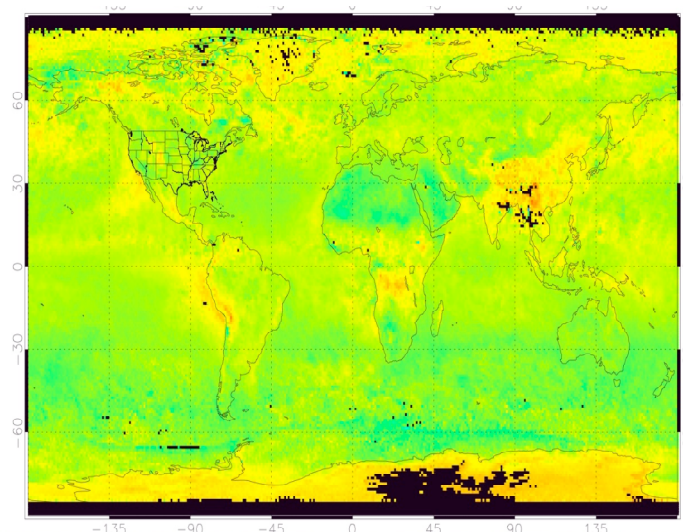
AIRS CO VMR (ppbv) at 500mb
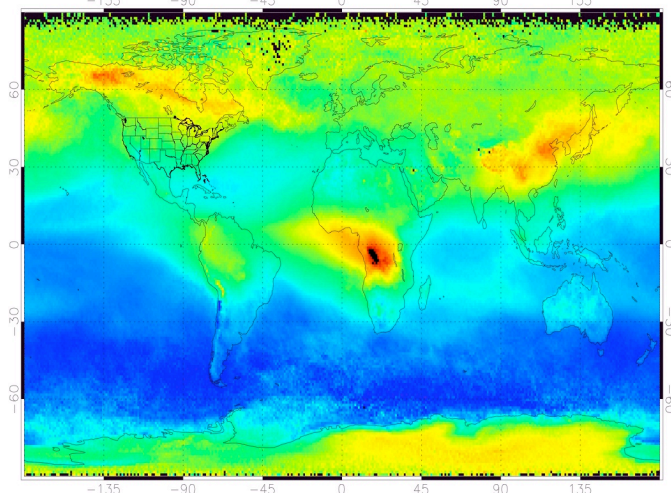
- Gridded at 1x1 degrees and averaged over June 15-Aug. 14, 2004
- AIRS retrievals used AFGL first guess profile
- Biases are on the average at 20 ppbv but can be as high as 50 ppbv over source regions and transported plumes.
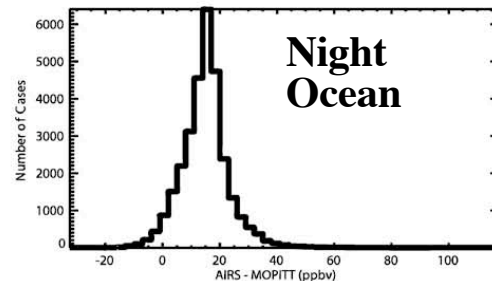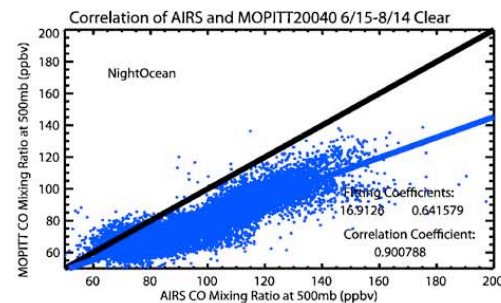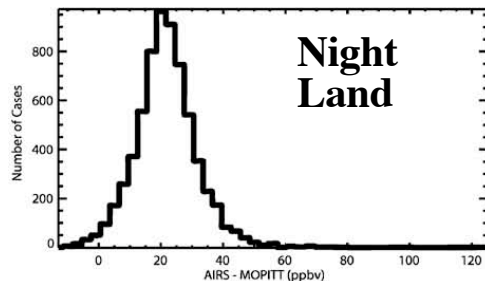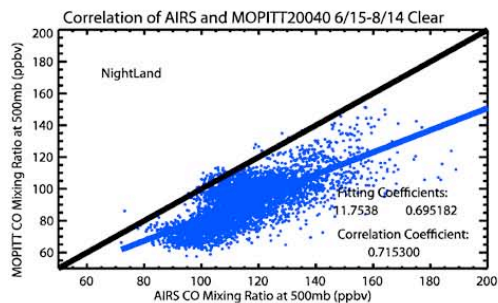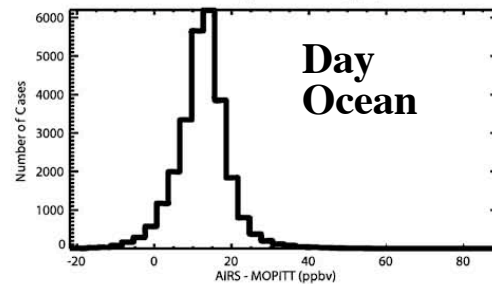
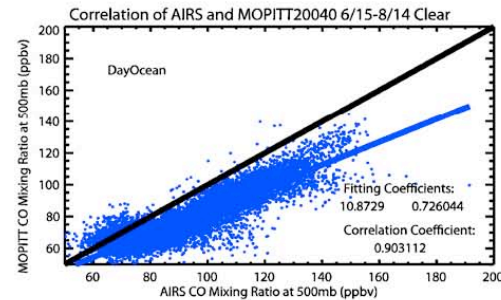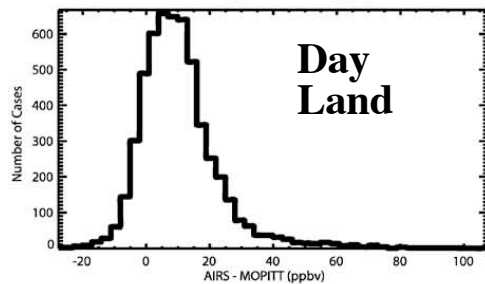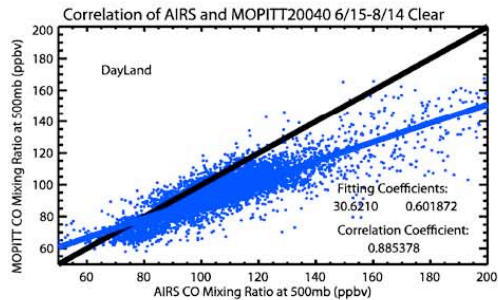### MOPITT CO VMR (ppbv) at 500mb
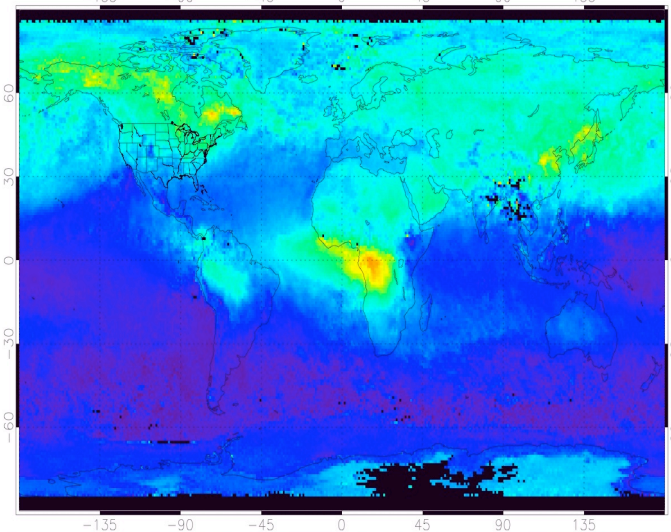
AIRS-MOPITT VMR (ppbv) at 500mb

CO MR at 500mb Direct Comparison AIRS (AFGL First Guess) vs MOPITT

CO MR at 500mb Comparison
AIRS (MOPITT *a priori*) vs MOPITT
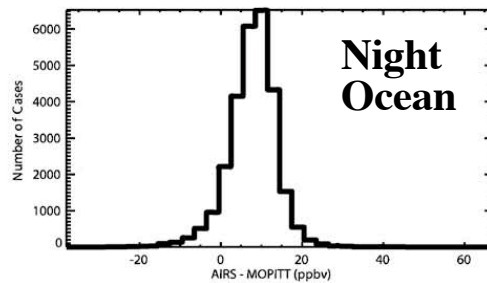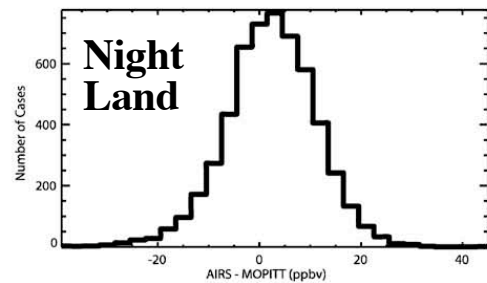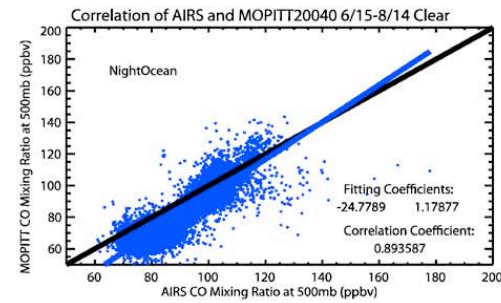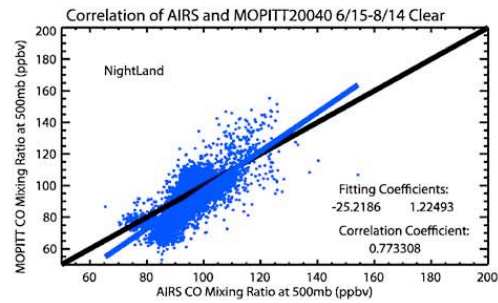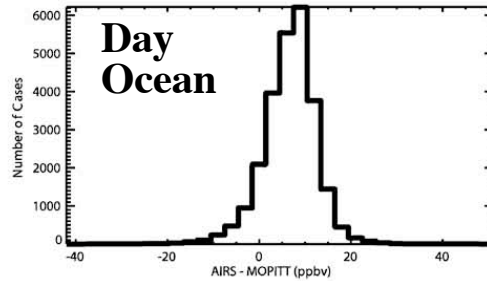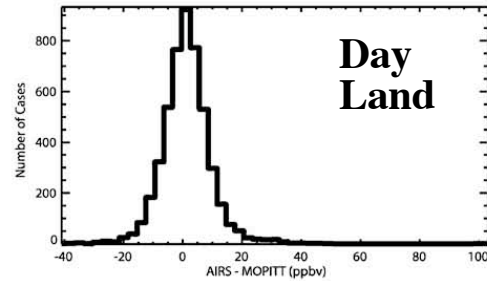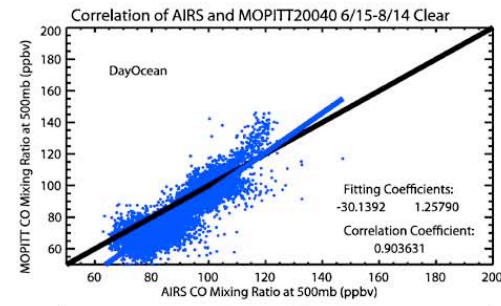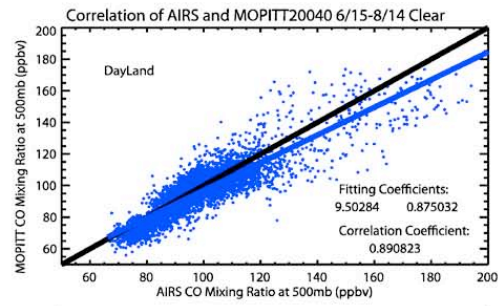
AIRS and MOPITT CO mr at 500mb Zonal Averages

• Using MOPITT *apriori* reduces AIRS CO data range even though the average of the two datasets agree better.

• Using the same *apriori* info increases the agreements, which demonstrates the strong dependence on the prior info from both datasets, however, not enough evidence to support which prior provide more realistic retrievals for AIRS.

Zonal Difference w/AFGL 1st guess 6/15-8/14, 2004 Clear

Zonal Difference w/MOPITT a priori 6/15-8/14, 2004 Clear
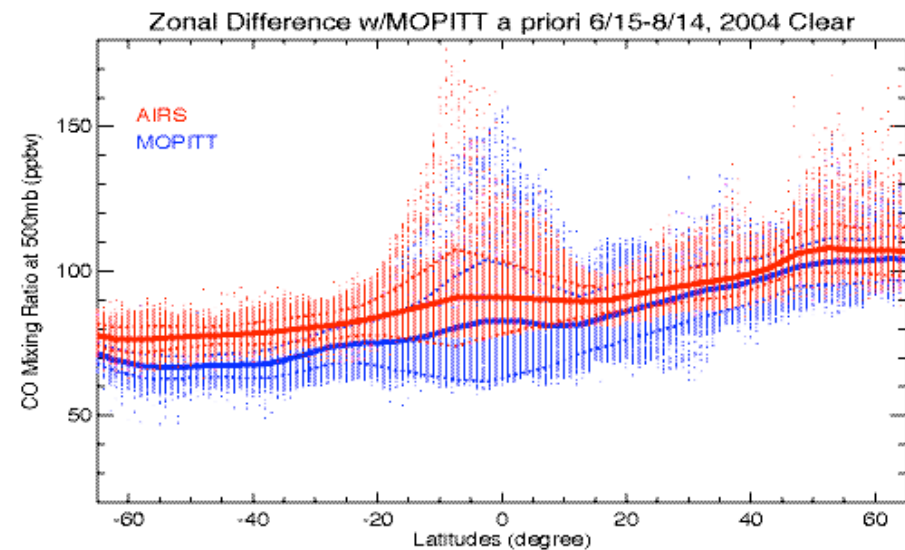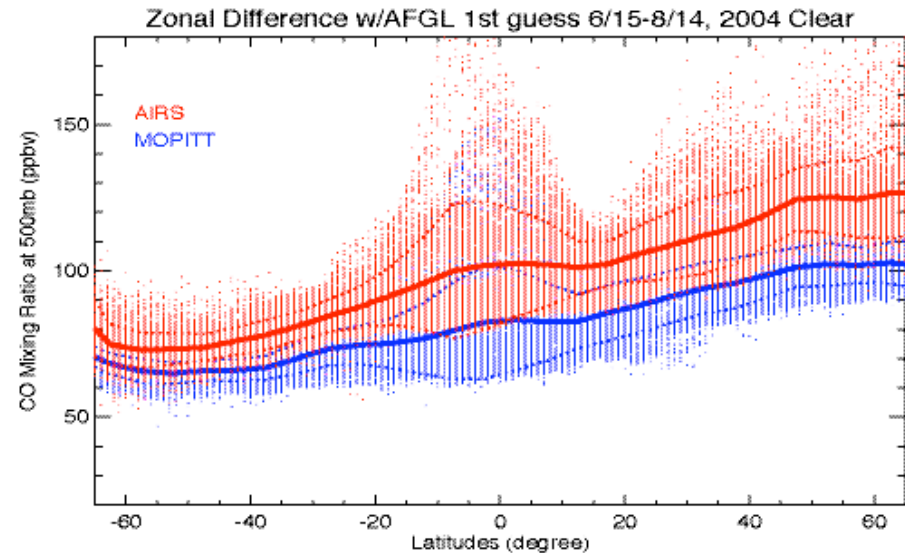
AIRS ~ MOPITT ~ *in-situ* CO profiles during INTEX-A
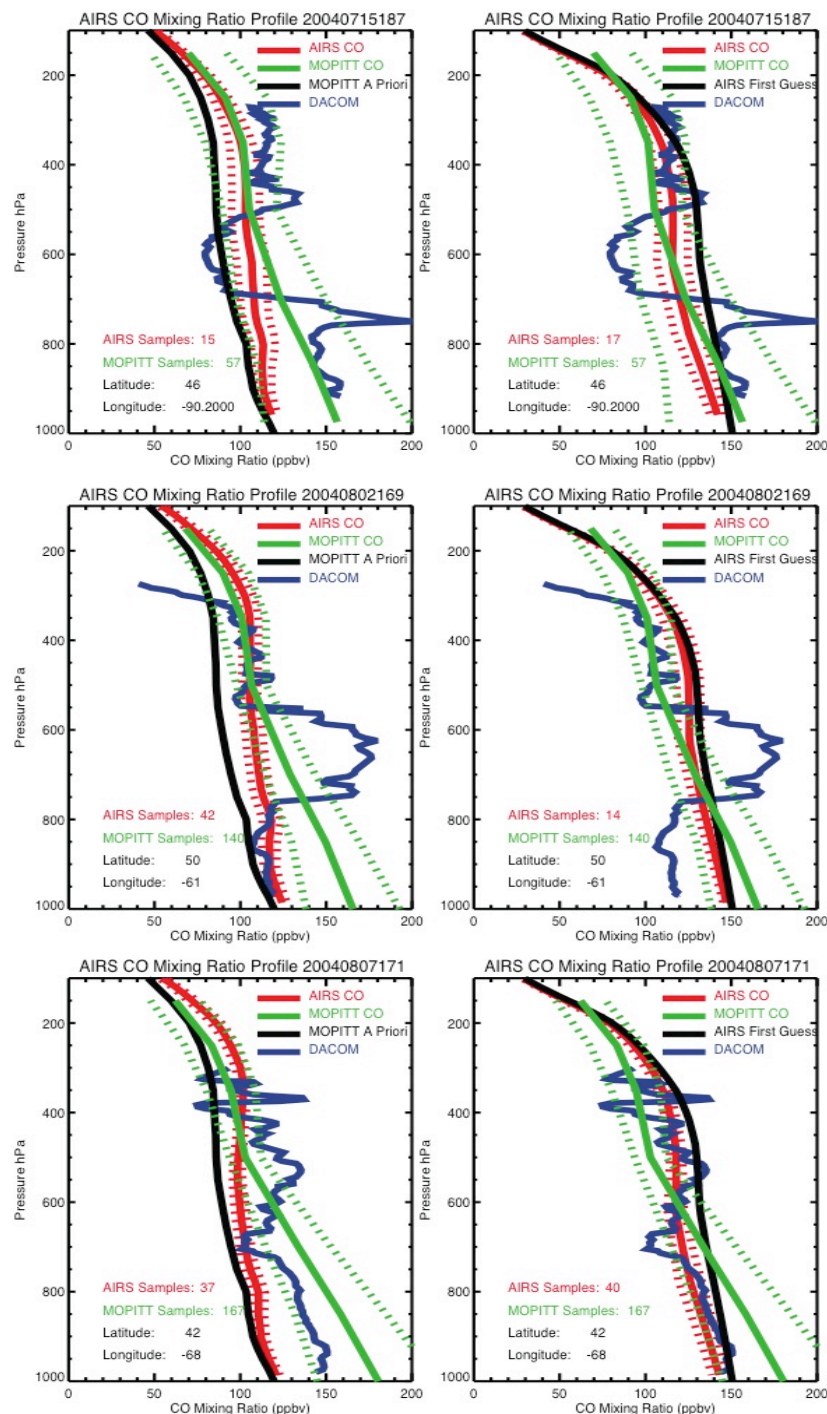
- **AIRS and MOPITT retrievals are averaged over 4x4 degrees.**

- **AIRS profiles capture the CO layer between 300 and 600mb well.**

- **The retrieved profiles are partially dependent upon the 1st guess profiles especially where there is little information.**

- **Needs to convolve the *in situ* for better understanding of the measurements**

AIRS/MOPITT/TES CO at 500mb (ppbv) for 20060408
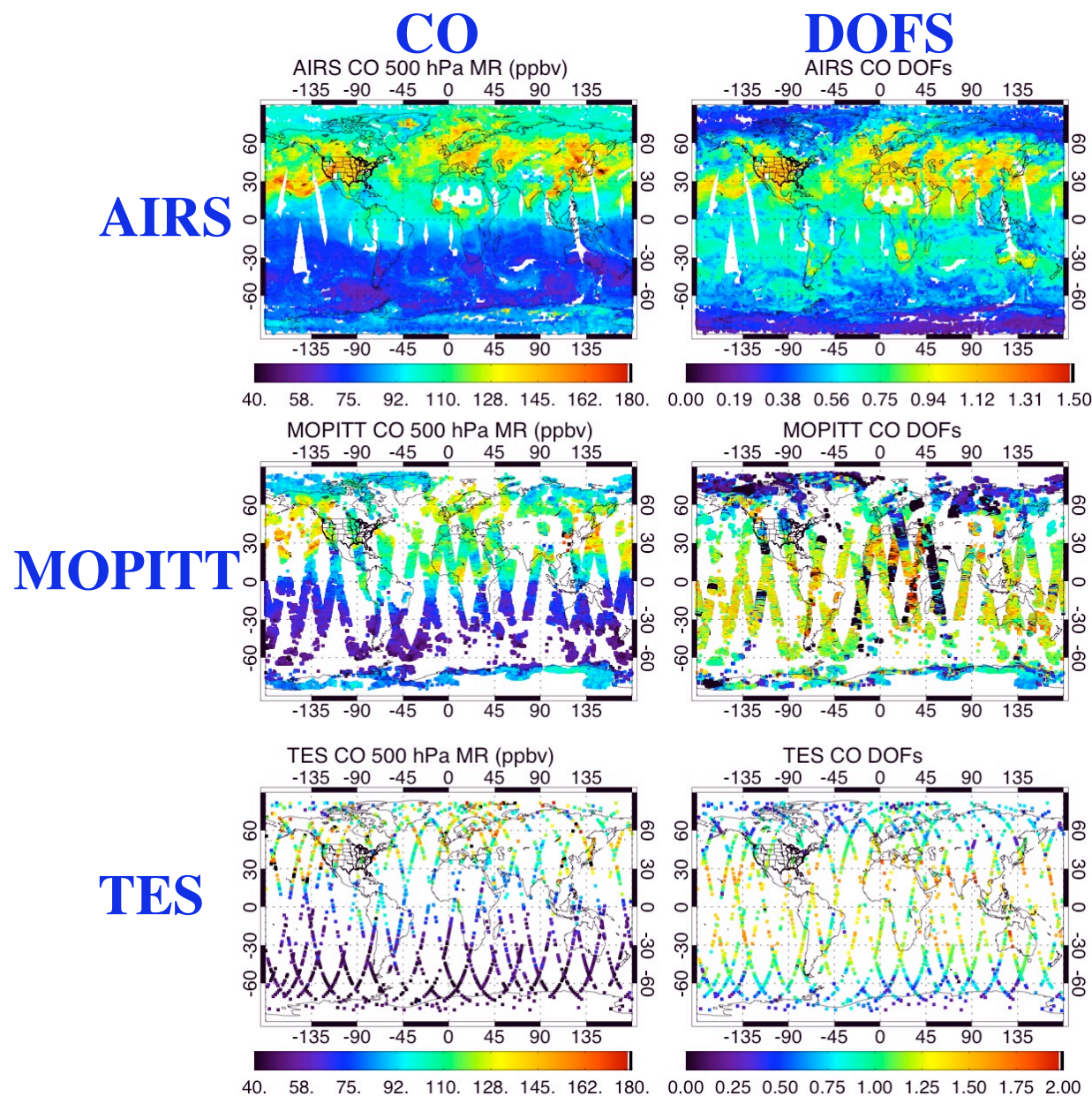
•AIRS high spatial coverage provides daily maps of CO distributions for transport studies due to its wide swaths and cloud clearing.

•Information contents are higher at lower latitudes, for all three sensors, and low at the polar regions where the temperatures are very low.

•Higher CO in the NH and lower in the SH with the highest contrast seen by TES.

AIRS/MOPITT/TES CO at 500mb (ppbv) for 20060408
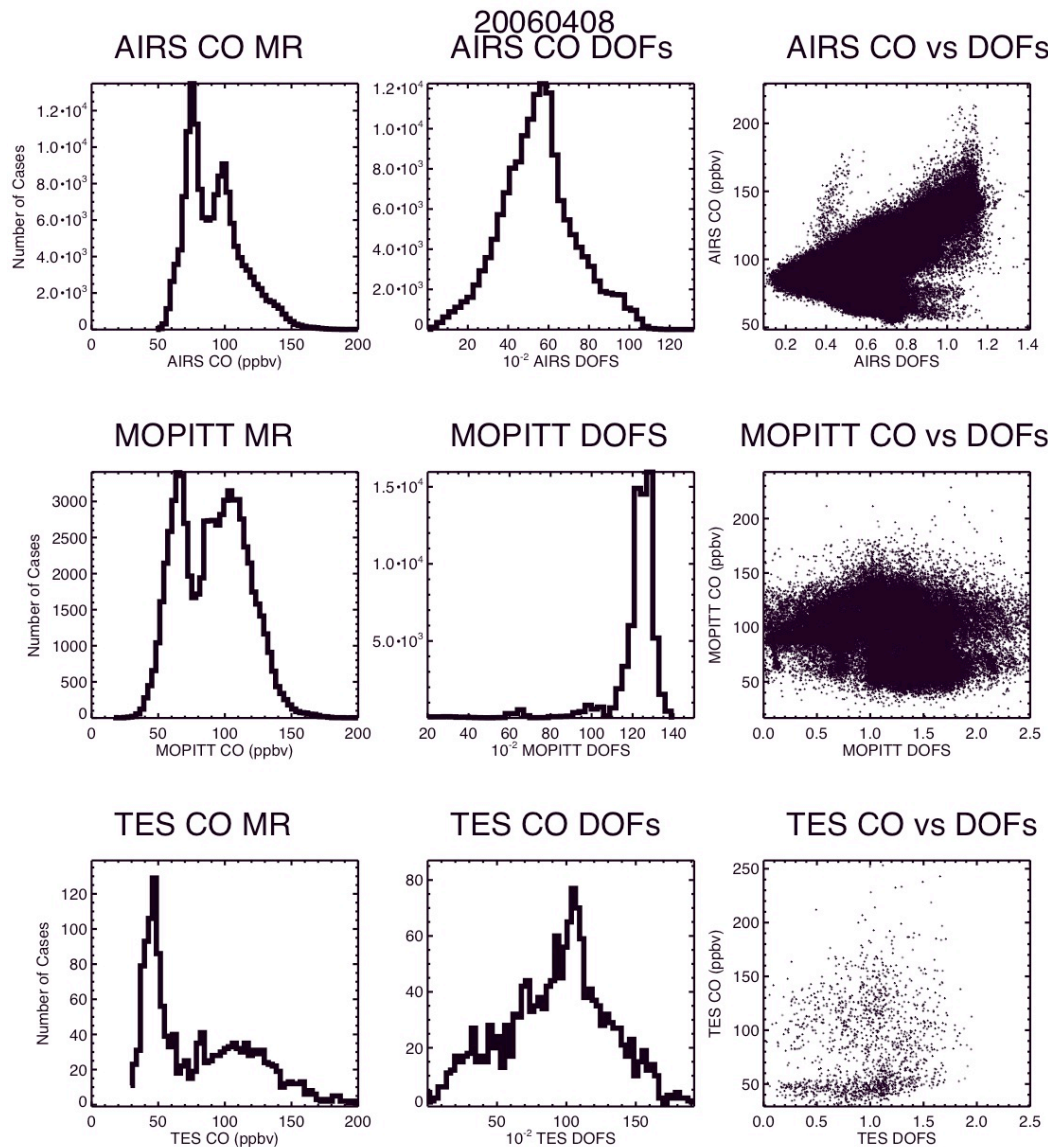
•Two peaks in the global CO histograms, one representing background clean air and the other over sources or due to transport.

•The DOFS shapes are similar between AIRS and TES.

•AIRS and TES DOFS are more correlated with the CO concentration than MOPITT.

AIRS~TES Comparisons in April-May 2006

AIRS CO Mixing Ratios at 500mb
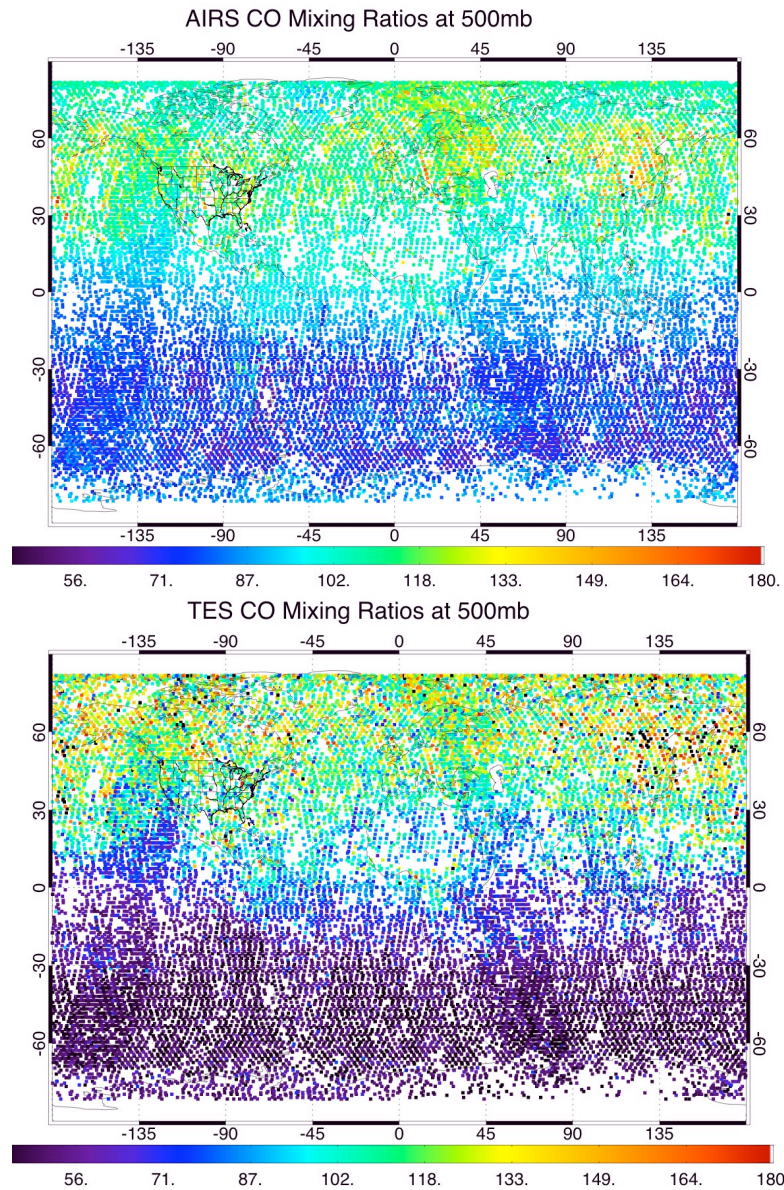
- AIRS are collocated to TES global surveys available in Apr-May 2006.

- TES showed higher CO in the NH with higher noise.

- TES CO lower than AIRS in the SH by ~30ppbv.

TES CO Mixing Ratios at 500mb

AIRS - TES CO Mixing Ratios at 500mb
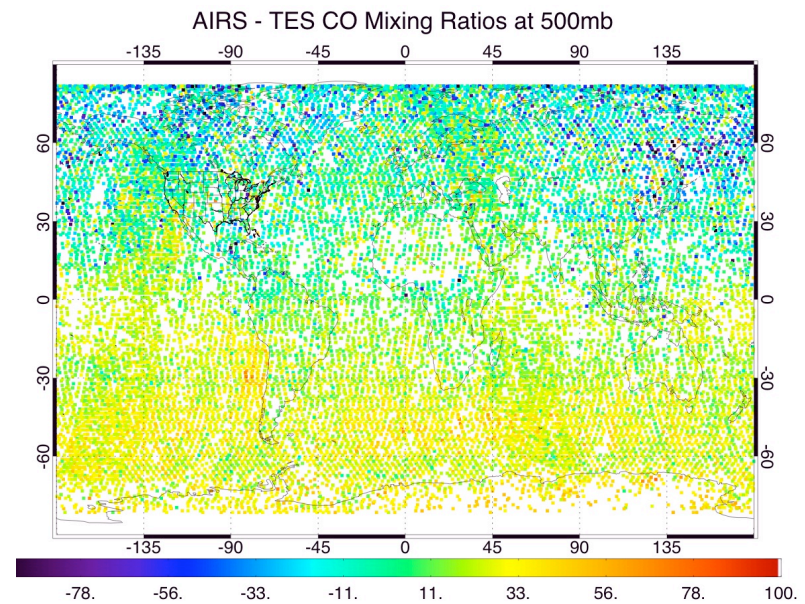
AIRS and TES CO correlations for April-May, 2006

•No obvious bias in the NH, however, the correlation coefficient is low
•An average bias of ~25 ppbv in the SH.

Zonal Averages of AIRS and TES CO and DOFS

Zonal Averages of AIRS & TES CO Mixing Ratios at 500mb

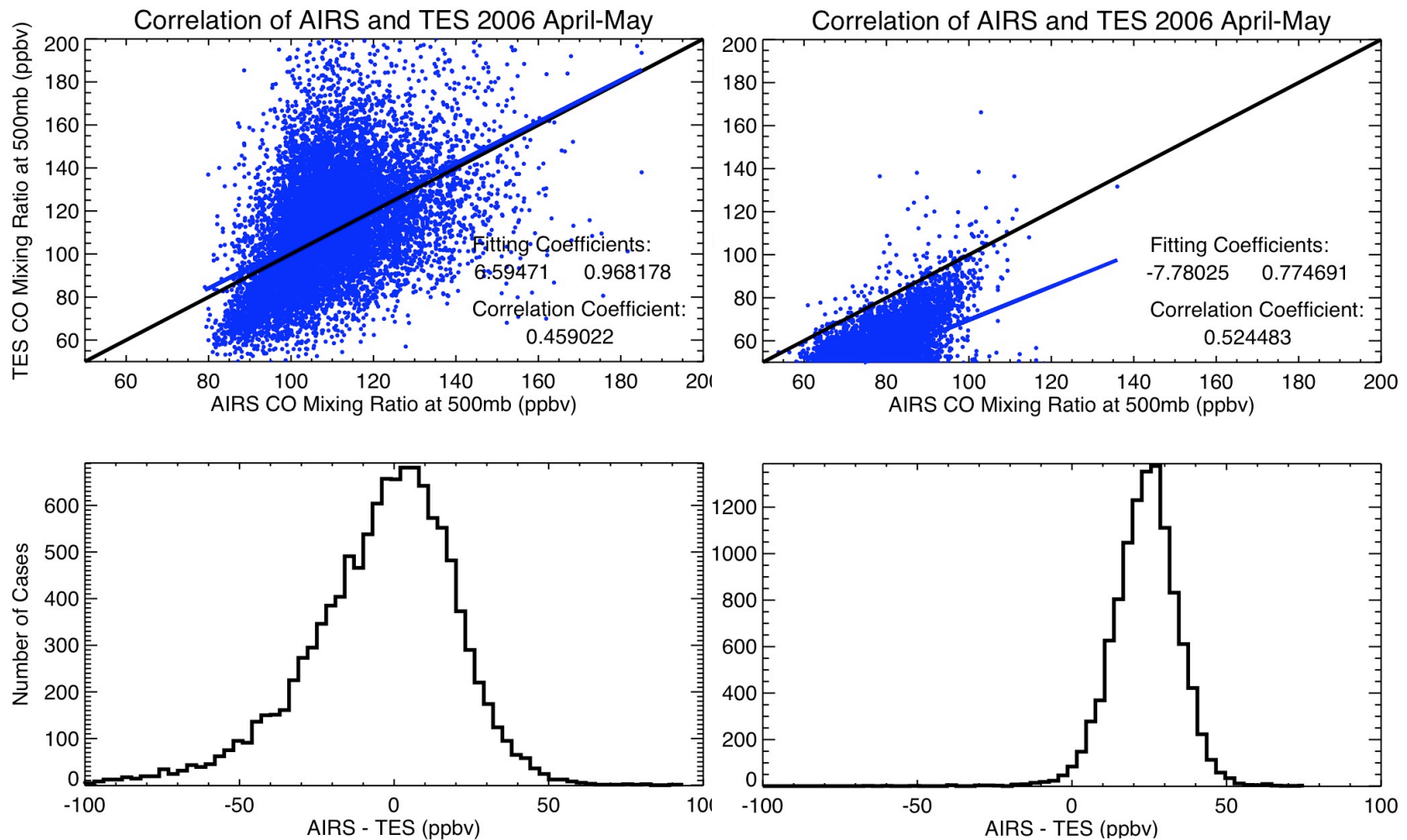Zonal Averages of AIRS & TES Degrees of Freedom
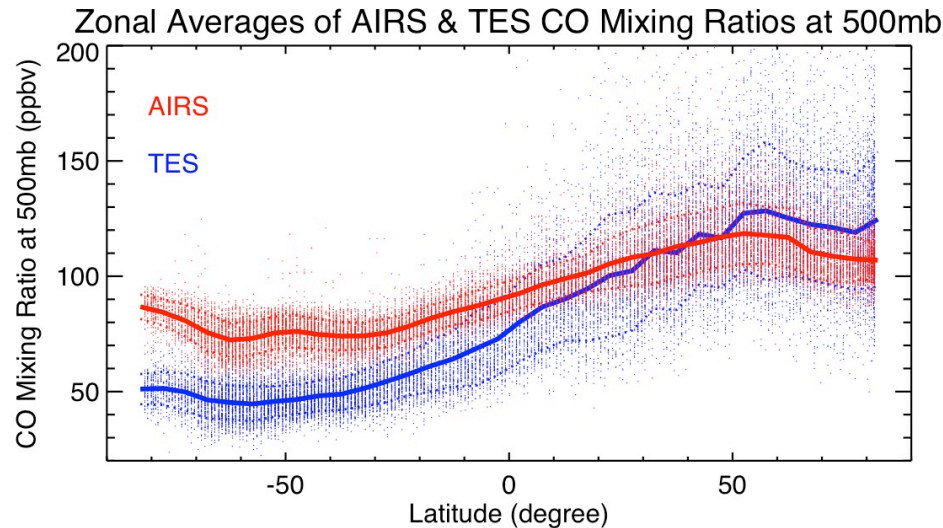
- AIRS and TES CO at 500mb agrees within ~10ppbv when MOPITT *apriori* is used in AIRS retrievals.

- The agreement will improve further if AFGL 1st guess profile is used.

- The distributions of the DOFS agree well between AIRS and TES, however, TES information content for CO is higher due to higher spectral resolutions.

Summary
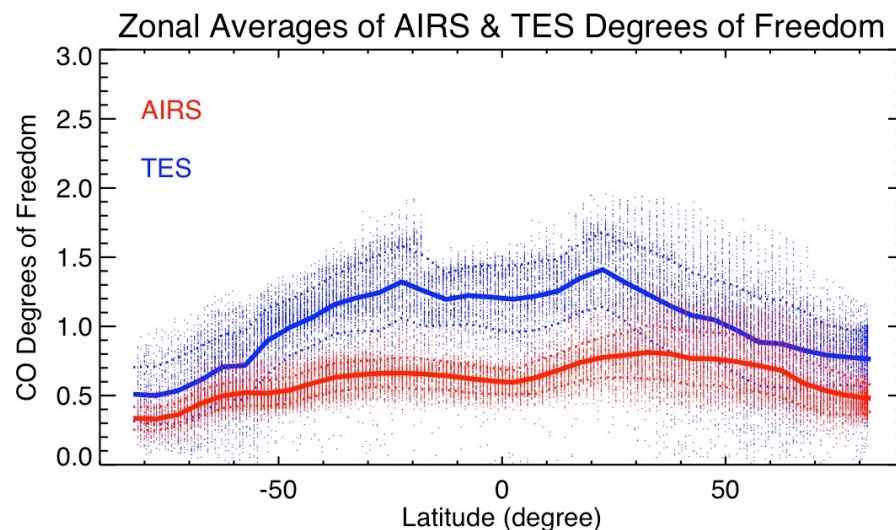
- **AIRS tropospheric CO measurements capture large features of the elevated CO on a daily basis due to its wide swaths and cloud clearing.**
- **AIRS/MOPITT/TES generally agree within 20 ppbv at all levels when the same *a priori* is employed (not shown).**
- **All three sensors agree better over the regions higher CO is observed, the largest differences are over the Southern Hemisphere ocean where the emission is minimum.**

Future Work

- **Future work will include the comparisons using more extended datasets including more spatial and temporal coverage and *in-situ* measurements.**
- **To understand the true observational differences between the sensors, the same retrieval algorithm and *apriori* should be used. We are recently funded (PI: Warner) to develop a research set of retrieval codes for AIRS CO using optimum likelyhood method. This work is largely motivated to benefit the comparisons between sensors and between algorithms for the same sensor.**